P-02-14

The use of hypobaric chambers for shelf life preservation of lamb loins (#257)

Stephanie M. Fowler[1], Lorraine Sphor[2], Norm Blackman[3], David Hopkins[3], The authors would like to thank John Archer, Cassius Coombs, Matt Kerr (NSW DPI) and Gerlane DeBrito (São Paulo State University, Jaboticabal, Brazil) for their assistance and the Australian Meat Processor Corporation for funding the research.

[1] NSW Department of Primary Industries, Centre for Red Meat and Sheep Development, Cowra, Australia; [2] 2NSW Department of Primary Industries, 3Centre for Greenhouse Horticulture and Market Access, Ourimbah, Australia; [3] 2 Sandra Place, Seaforth, Australia

Introduction

Consumer demand is increasing for premium imported lamb in wet markets and as consumer demands increase, methods for export complimentary to live export will be required to ensure demand can be met. Improvements in hypobaric chamber technologies have resulted in the use of such chambers to transport perishables. Therefore, the use of hypobaric chambers to maintain shelf life of lamb loins was explored.

Methods

Loins from 24 lamb carcases were collected 24 hr post mortem and sections were excised for microbiology and oxidative stability tests (TBARS). Loins were then weighed and assigned to one of three treatment groups; vacuum packaged (control), CO_2 hypobaric chamber and air hypobaric chamber. After 5 weeks storage in the treatment at 0°C, loins were removed and reweighed (to determine purge) before sections were excised to measure pHu, microbiological load, retail colour stability, TBARS and carbonyl content [1, 2]. This was replicated 4 times (n = 96). REML mixed models with replication, chamber and side of the carcase as random effects were used to determine if a significant difference between treatments was present. Microbiological data was analysed using a comparison of 95% confidence intervals for proportions, generalised linear models with poisson errors or log link function for counts and generalised linear models with binomial errors and logit link function for proportions.

Results

Purge for loins stored in hypobaric chambers was more than double the purge for loins stored under control conditions. As it is the loss of fluid from extracellular channels when meat is exerted to the pressure of vacuum packaging, it is likely that the storage of the loins in hypobaric chambers under continual vacuum conditions facilitated the loss of a greater percentage of water as ageing alters the structure and net charges of the myofibril and immobilised water migrates to extracellular channels where it can be lost [3]. There was a significant difference in the decline of a* values as the air chamber treated loins fell below the consumer threshold after 2 days of stimulated retail colour display ($P < 0.001$). Furthermore, the loins treated in both chambers fell below the threshold of the 630/580nm ratio on day 2, while those in the control group did not fall below the threshold until day 3. It is hypothesised that these changes in colour stability are the result of altered oxidative capacity as isocitrate dehydrogenase activity has been shown to affect the 630/580nm ratio [4]. However, denaturation of myoglobin from cellular disruption during storage has also been implicated [2].

The significant increase in *Enterobacteriaceae* found for loins held in the CO_2 chamber and significantly higher counts of *B. thermosphacta* found on loins held in both hypobaric chambers indicate that the combination of pressure, humidity and temperature used in this study did not produce an environment which was inhospitable to microbial growth. While research on packaging suggests that CO_2 can affect meat pH in modified atmosphere packaging (MAP) [5], pH was not found to significantly differ between treatment groups. Given that counts of *B. thermosphacta* and *Enterobacteriaceae* have been associated with oxygen availability during storage [6], it is likely that the conditions in the chambers using CO_2 and air did not create the anaerobic environment required to inhibit such microbial growth.

Conclusion

Overall, this study indicated that there is a limited ability to utilise hypobaric chambers with CO_2 and air to store fresh lamb for a period of 5 weeks. Lamb loins held under hypobaric conditions yielded higher purge loss, increased discolouration during stimulated retail display and higher counts of *B. thermosphacta* and *Enterobacteriaceae* compared to those stored in vacuum packaging at the same temperature.

REFERENCES

1. Holman, B.W.B., Coombs, C.E.O., Morris, S., Kerr, M.J., and Hopkins, D.L. (2017). Effect of long term chilled (up to 5 weeks) then frozen (up to 12 months) storage at two different sub-zero holding temperatures on beef: 1. Meat quality and microbial loads. Meat Science, 133: 133-142.

2.Coombs, C.E.O., Holman, B.W.B., Collins, D., Friend, M.A., and Hopkins, D.L. (2017). Effects of chilled-then-frozen storage (up to 52weeks) on lamb M. longissimus lumborum quality and safety parameters. Meat Science, 134: 86-97.

3. Pearce, K.L., Rosenvold, K., Andersen, H.J., and Hopkins, D.L. (2011). Water distribution and mobility in meat during the conversion of muscle to meat and ageing and the impacts on fresh meat quality attributes — A review. Meat Science, 89: 111-124.

Notes

4. Calnan, H.B., Jacob, R.H., Pethick, D.W., and Gardner, G.E. (2014). Factors affecting the colour of lamb meat from the longissimus muscle during display: The influence of muscle weight and muscle oxidative capacity. Meat Science, 96: 1049-1057. 5. Holman, B.W.B., Kerry, J.P., and Hopkins, D.L. (2018). Meat packaging solutions to current industry challenges: A review. Meat Science, 144: 159-168. 6. Coombs, C.E.O., Holman, B.W.B., Friend, M.A., and Hopkins, D.L. (2017). Long-term red meat preservation using chilled and frozen storage combinations: A review. Meat Science, 125: 84-94.

Trait	Mean			s. e.	LSD	$F_{2,6}$ P valu
	Control	Air	CO_2			
Purge Loss (%)	3.02 a[T]	6.81 b	6.43 b	0.91	2.29	0.01
Lipid Oxidation (MDA mg/kg)	1.08	1.09	1.18	0.15	-	0.81
pHu	5.68	5.69	5.69	0.02	-	0.82
Carbonyl Content (nmole/ mg protein)	4.18	4.42	3.98	0.45	-	0.31

[T]Means with different letters are significantly different at P = 0.05.

Table 1

The predicted means for each trait measured across the treatment and control groups with the least significant differences (LSD) of means and the standard error (s. e.) of the mean.

Notes